CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Carbon dioxide (CO_2) is a nonflammable, colorless, and odorless in any phase either gas or liquid. Current atmospheric CO_2 increase is caused by anthropogenic CO_2 emissions. Increasing CO_2 due to combustion of fossil fuels such as oil, natural gas and coal. About three quarters of this production is caused by burning fossil fuels (Prentice et al., 2001). About a quarter is due to the addition of vehicles, industry and human. In 2015, based on global CO_2 emission per region from fossil-fuel use and cement production, China released nearly 25000 million tonnes of CO_2 followed by other non-OECD1990 Europe countries about 13000 million tonnes CO_2 and Russian Federation by 12000 million tonnes of CO_2 (Olivier et al., 2015).

CO_2 is the primary gaseous element of the greenhouse gases in the atmosphere, indicating approximately 80% and contribute significantly to global warming (Rongwong et al., 2009). Industries manufacturing ammonia and urea produce wastewater that consumes high CO_2 concentrations (Agrahari et al., 2011). In plant, higher ratio of CO_2 to bicarbonate ion immediately declines pH of water, which causes corrosion of piping materials (Mansourizadeh and Ismail, 2012). The technique of removing CO_2 can be accomplished via numerous techniques which are pressure swing adsorption, cryogenic distillation, packed column and membrane technology (Simons et al., 2009; Zheng and DeMontigny, 2013). Lately, membrane contactor have received several attention because of its advantages including high contact area per unit volume, compatible to absorb CO_2, no loading and flooding constraints (Crespo et al., 1995).

Membrane contactor has the ability to perform mass transfer without dispersion of one phase within any other either gas/liquid mass transfer or liquid/liquid mass transfer, have a high operational flexibility and viable alternative for various applications (Stanojevi, 2003; Steenhoven et al., 1994). In membrane technologies more especially in hollow fiber membrane are extensively used nearly in all membrane processes, especially in ultrafiltration, microfiltration, gas permeation and pertraction via polymeric or liquid membranes. Currently, hollow fiber contactors have started to be used in membrane based methods in two phase contactors (Kert, 2005).

Hollow fiber membrane contactor indeed are more effective than others conventional absorption technologies but it also have several disadvantages such as tend to fouling for long term use, short lifetime, pretreatments needed to reduce fouling, and wetting problem whereby it can decline the efficiency of the membrane drastically (Criscuoli and Drioli, 2009). In order to prevent that problem, the membrane must be highly hydrophobic to avoid the membrane pore filled with aqueous absorbent solution.

Polyvinlylidene fluoride, polytetrafluoroethylene and polypropylene were considerably used for the preparation of microporous hydrophobic membranes utilized in membrane contactor. Among these polymers, only PVDF has an amazing solubility in many organic solvents (Hee et al., 2009). PVDF has been intensively studied due to its excellent bulk properties, along with high electric resistance as well as good thermos-stability, light weight and suitable process ability. Those properties have made PVDF increasingly more used in various fields which include filtration, air cleaning, and rechargeable batteries (Huang et al., 2010). Modification PVDF to turn out to be ceramic membranes are made from metal oxides, including alumina, zirconia, silica and so on, which are hydrophilic in nature due to the presence of hydroxyl (OH–) groups on the surface.

In the present study, the main objective is to produce of hydrophobic PVDF hollow fiber membrane with addition of alumina clay for CO_2 absorption via membrane contactor.

1.2 Motivation

The removal of CO_2 is vital in order to reduce the greenhouse effect hence to reduce the global warming. Based on the issues, many researchers began to look for innovation to reduce CO_2 emissions through the creation of a gas separation application. There are many traditional technologies for gas separation such pressure swing absorption, distillation column and gas-liquid extraction. However, each has disadvantages such as requiring large area to build and high cost of construction/maintenance. Meanwhile, membrane contactor is most appropriate in this century because of high contact area per unit volume, easy process integration and compatible to absorb CO_2.

1.3 Problem Statement

There are two problems that concern which are the release of CO_2 and corrosion in the pipeline. CO_2 is one of acidic gasses which need to expel from regular gas pipeline because it contributes to equipment corrosion. This is because corrosion will lead to produce a product which not in good quality. not only that, the addition of impurities if corrosion not prevented. Membrane wetting is the main problem of gas–liquid membrane contacting processes. The negative effects of membrane wetting on absorption performance and mass transfer resistance have been widely observed by researchers (Boributh et al., 2013; Lv et al., 2010). Membrane wetting influence by membrane characteristics, absorbent properties and operating conditions. Therefore, the need of it is essential to have hydrophobic polymer materials that withstand the membrane from getting wetted at prolong hour operation.